BaudMaster ™

BM485
Serial Data Interface Converter

User's Manual
Rev. 1.0 6/28/04

Innovative I/O Since 1977

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BaudMaster™

BM-485
Isolated Serial Data Interface Converter
User's Manual

5 Year Warranty

Interface converter products, sold by duTec, Inc., are warranted against defects in materials and workmanship for five years from the date of purchase. There are no other express or implied warranties and no warranty of merchantability or fitness for a particular purpose.

During the warranty period, duTec will repair or, at its option, replace components that prove to be defective, provided the unit is shipped prepaid to the manufacturer directly or via and authorized distributor. Not covered by this warranty are defects caused by modification, misuse or accidents and any further damage caused by inadequate packing for service return.

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Table of Contents

Introduction 1

Features 1-2

Specifications 3-4

Description 5-12

Configuration 13-16

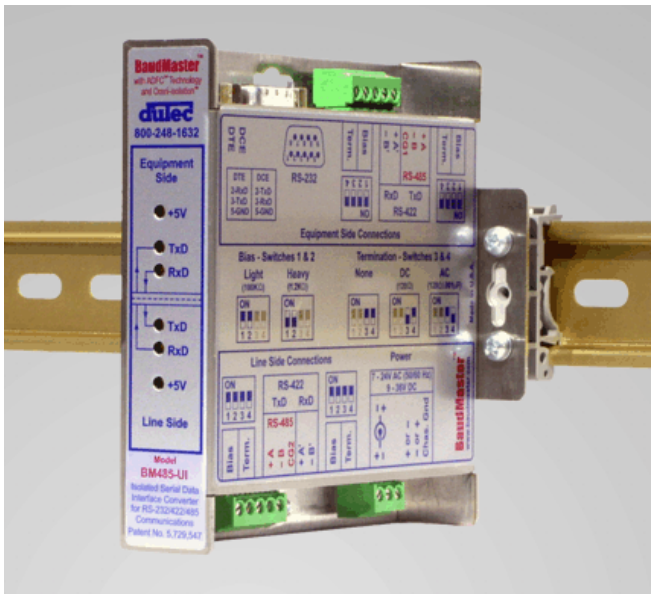
Wiring 17-20

Ordering Information 23

Cable 25

Introduction

RS-232, RS-485 and RS-422 are among the most successful and widely used serial interface standards for industrial applications. Although these standards are not directly compatible with each other, it is often necessary to communicate between them. In order to convert RS-232 signals to RS-485 or RS-422 signals a special device is required. The BaudMaster™ family of interface converters are designed to easily convert data between all of these standards. The BaudMaster™ automatically controls the direction of serial data eliminating the need for software flow control. Using a patented technique (Automatic Data Flow Control, ADFC™), BaudMaster™ interface converters automatically adapt to any baud rate up to 115,200 baud and is independent of communications protocol. The BaudMaster™ can be used in your industrial applications without any hardware or software changes.



Features

Omni-Isolation™ Optical and transformer isolation technology provide up to 2000 volts of signal and ground isolation between the computer and equipment. Eliminates ground loops that destroy computer ports and reduce serial communications reliability. (See page 5)

ADFC™ ADFC™ (Automatic Data Flow Control), uses a technique protected by U.S. patent no. 5,729,547 that automatically senses and controls the direction of RS-485 data eliminating the need for software control.

3-in-1 Signal Conversion Converts RS-232 to RS-485, RS-232 to RS-422 or RS-485 to RS-422. Automatically senses RS-422 four-wire operation.

Status LEDs Status LEDs are provided on both sides of the isolation for the Power, Transmit and Receive signals. These are handy for verifying operation and troubleshooting network problems.

Transient Voltage Protection All signal and power lines are protected against transient

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voltages.

Switch Selectable Termination and Bias Resistors Network termination and bias can easily be configured with DIP switches available from the outside the converter case. The switches are clearly identified on the label for easy setup.

DTE-DCE Selection A switch easily makes the BaudMaster™ either a DTE or a DCE device so the unit will communicate with a DCE or DTE device, or operate with a "straight-through" or "null modem" cable.

Echo With the echo feature enabled, data is echoed back to the equipment side port. This may desirable or required with some protocols. The default is no echo.

Baud Rate Independent No switches or jumpers to set. Automatically adapts to all standard and non-standard baud rates up to 115,200 baud**.**

Versatile Power Supply The unit can be powered by a wide range of AC or DC voltages. Wall-plug adapters are available from duTec or others. A pluggable screw terminal is also provided for use with other power supplies. 7 to 24 volts AC or 9 to 36 volts DC @ 170mA max.

Pluggable Terminal Blocks Industrial rated pluggable terminal blocks for ease of installation or removal. Accepts up to 16 AWG wire.

DIN Rail Mounting DIN Rail mounting accessories available for easy wiring.

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Specifications

Isolation	Omni-isolation™ provides 4-way isolation using optical and transformer technology. Equipment-to-Line, Equipment-to-Power, Line-to-Power, Equipment-to-Chassis, Line-to-Chassis, Power-to-Chassis. Hi-Pot: 2000 V_{RMS} for 1 minute, 5500 VDC for 1 second Leakage Current: Less than 50uA @ 2000 VAC / 60 Hz; 5500 VDC
Baud Rate	0 to 115.2K bps
Range	4000 feet (1220 meters) @ 38.4K bps with 24 AWG twisted pair
Weight	12.8 oz. (363 grams)
Power	9 to 24 volts AC or DC @ 170mA (max)
Enclosure	18 gage Stainless Steel
Dimensions	Height: 4.60 inches (117mm) Depth: 4.16 inches (106mm) Width: 1.00 inch (25mm)
RS-485/422	Supports RS-422, 4 or 2 wire and RS-485, Auto Detect Input Resistance: 12K to 15K ohms (1 unit load) Drive: Up to 32 unit loads (1 unit load = 12K ohms) Connector: Pluggable Terminal Blocks (#16 to #24 AWG) Biasing Resistors: Selectable 100K or 1.2K ohms Terminating Resistors: Selectable NONE, AC or DC
RS-485 Enable	Automatic. Patented ADFC™ technology automatically controls data direction flow.
RS-232	Supports TxD, RxD, DTR, DSR, RTS, CTS, DCD; Connector: DB9 Male or Female DCE or DTE selectable
Operating Temperature	-20°C to +80°C
Storage Temperature	-45°C to +100°C
Humidity	5% to 95% RH
Compliance	Pending (CE, FCC Class A, CUL, UL Safety Class II)
Accessories	DIN Rail Mounting Kit: Part No DA-01 AC Power Adapter: North American: 120 VAC Input AC Power Adapter: European: Universal Input: 90-264 VAC Input
Surge Protection	600 Watt Transient Voltage Suppression on RS-485/422 inputs and outputs, RS-232 inputs and outputs and Power input.
Indicators	Equipment Side: Power, RxD, TxD LEDs Line Side: Power, RxD, TxD LEDs

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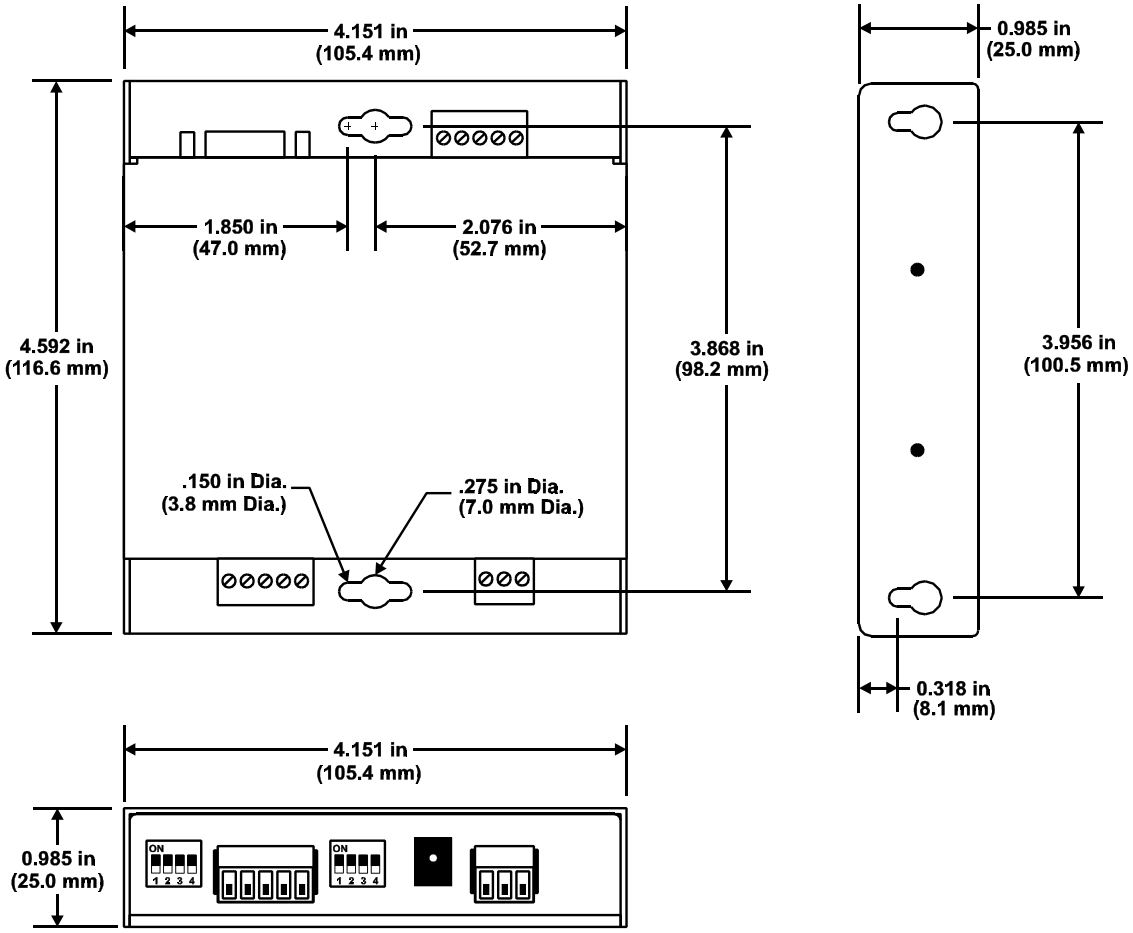
Dimensions



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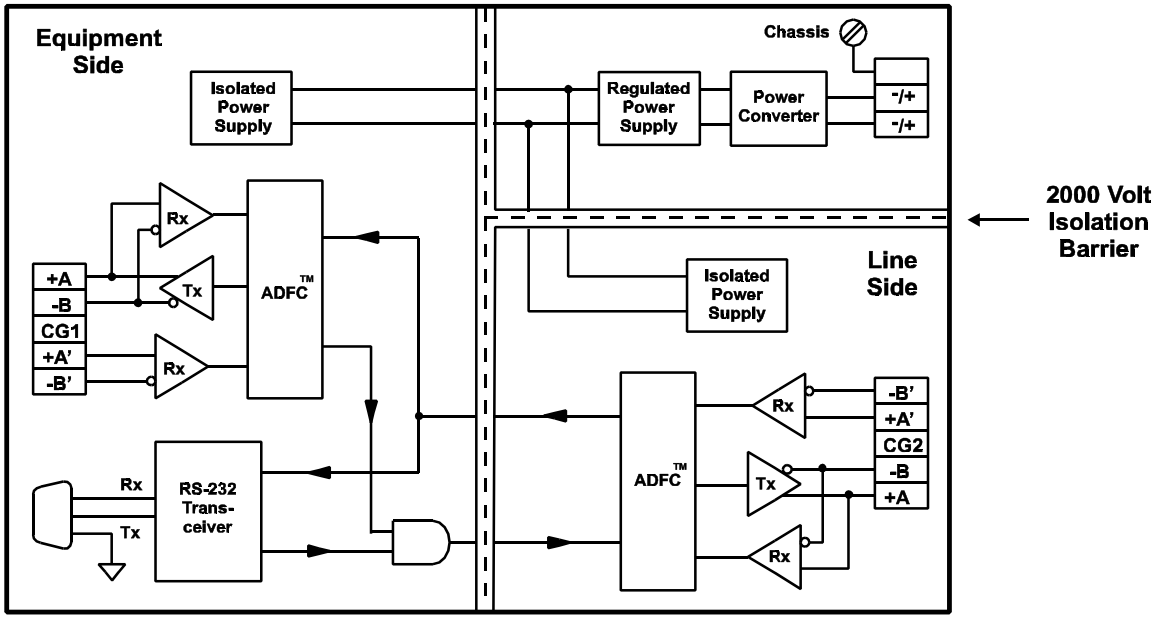
Description

The BaudMaster™ Model BM485-UIP is our most versatile interface converter. It can operate in one of the following six modes as a converter, isolator or repeater: RS-232 to RS-485, RS-232 to RS-422, RS-485 to RS-422, RS-485 to RS-485 or RS-422 to RS-422. The diagram below shows the function blocks, signal paths and isolation.



Omni-isolation™ provides full galvanic isolation using optical and transformer technology: Equipment-to-Line, Equipment-to-Power, Line-to-Power, Equipment-to-Chassis, Line-to-Chassis, Power-to-Chassis. Full galvanic isolation breaks the signal, power and ground paths using transformer and optical technology by allowing data to flow between systems, but not electrical current. This eliminates all grounding and surge problems.

The ADFC™ (Automatic Data Flow Control) function block controls the flow of serial data. ADFC™ technology uses a technique that continuously monitors data and automatically senses and controls the direction of RS-485 data eliminating the need for software control. Other techniques control the flow of data with a precision timer that must be configured for the correct baud rate or only enables the transmitter on a "one" bit and relies on the biasing resistors to maintain the correct voltage for a "zero" bit. ADFC™ is superior to both of these methods in that the transmitter is enabled for the entire transmission and is independent of baud rate.

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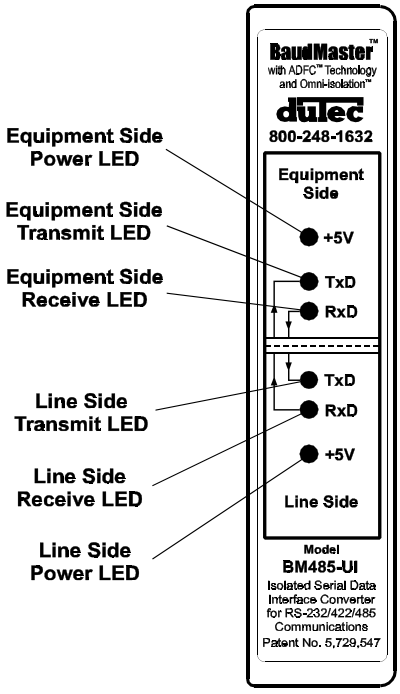
LED Indicators

Depending on the model, the BaudMaster™ has up to six status LED indicators. These indicators show the status of data communications and power and are handy for verifying operation and troubleshooting network problems.



Equipment Side

LED Name	LED Function
+5V	Red indicates the Equipment Side power is on.
TxD	Transmit - Red indicates that the Equipment Side is sending data to the port.
RxD	Receive - Red indicates that the Equipment Side is sending data to the Line Side.

Line Side

LED Name	LED Function
+5V	Red indicates the Line Side power is on.
TxD	Transmit - Red indicates that the Line Side is sending data to the port.
RxD	Receive - Red indicates that the Line Side is sending data to the Equipment Side.

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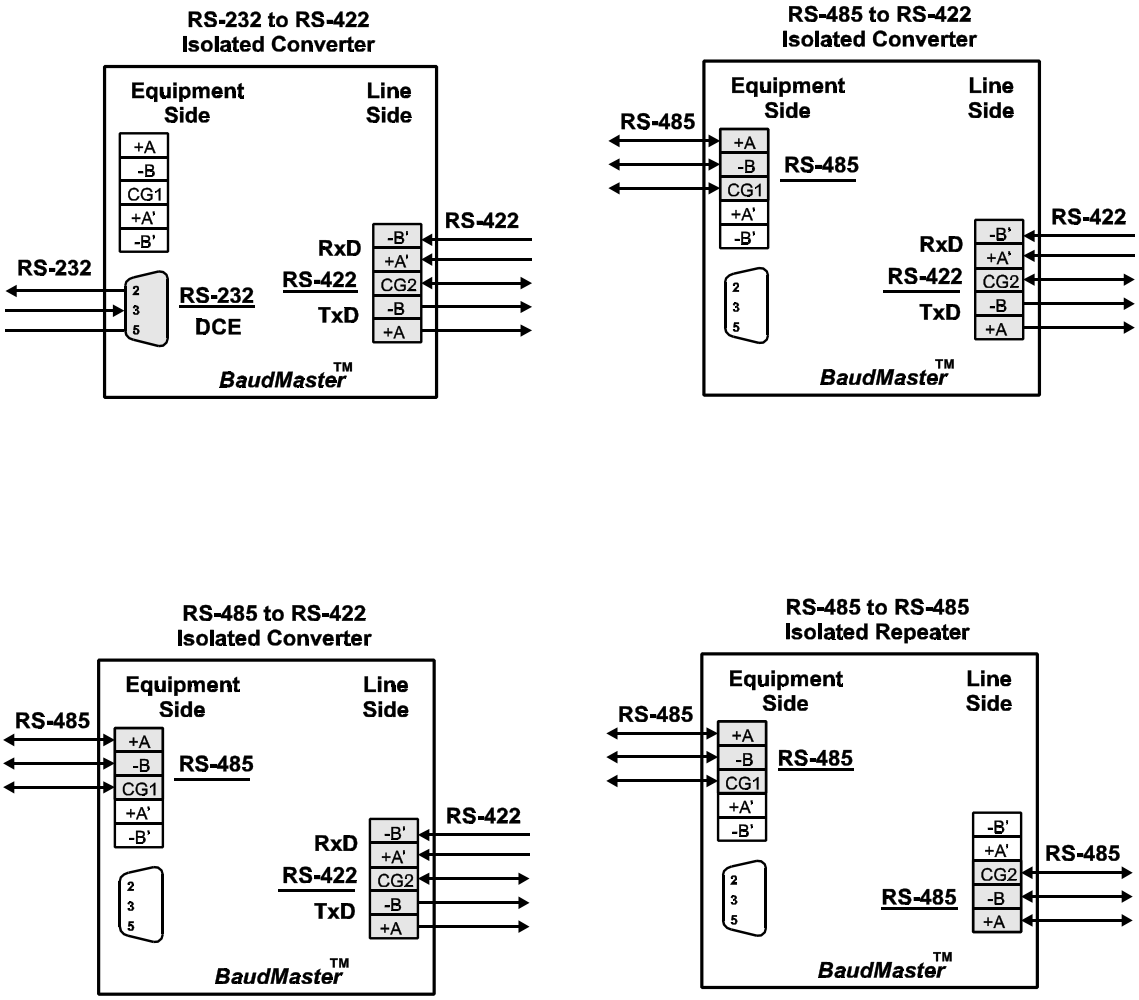
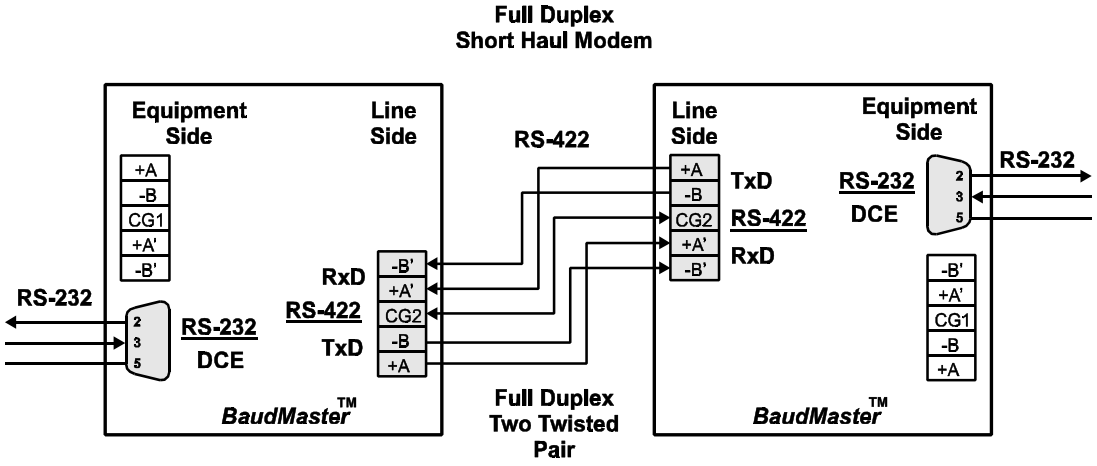
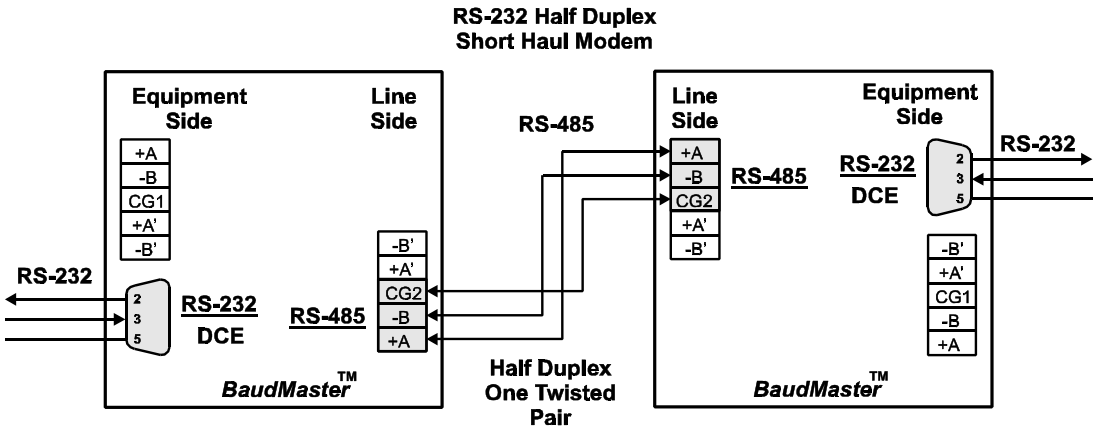
Typical Applications

Isolators • Repeaters • Converters



Short Haul Modems





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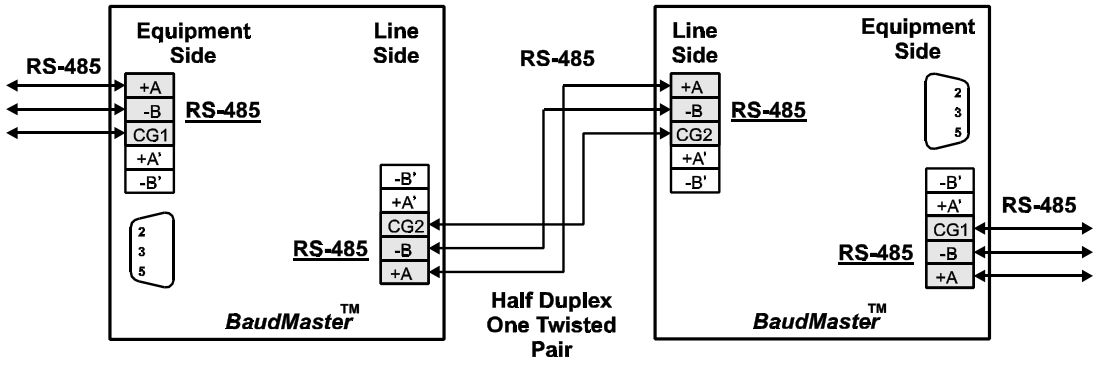
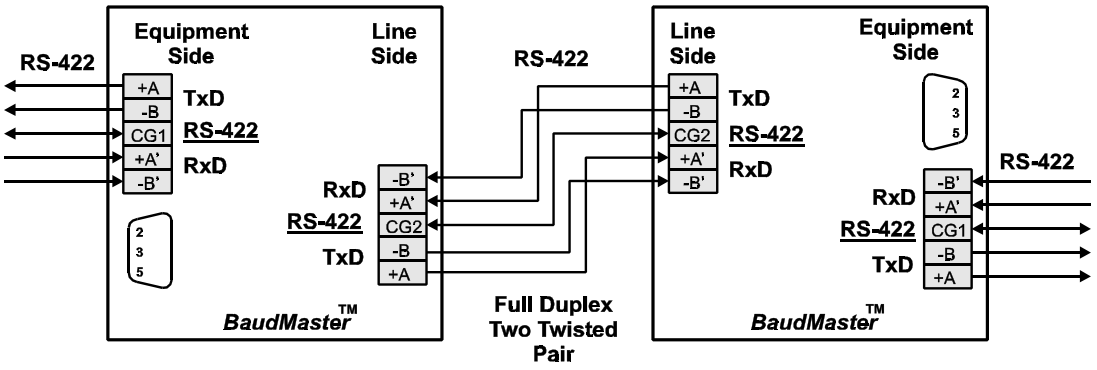
Line Extenders

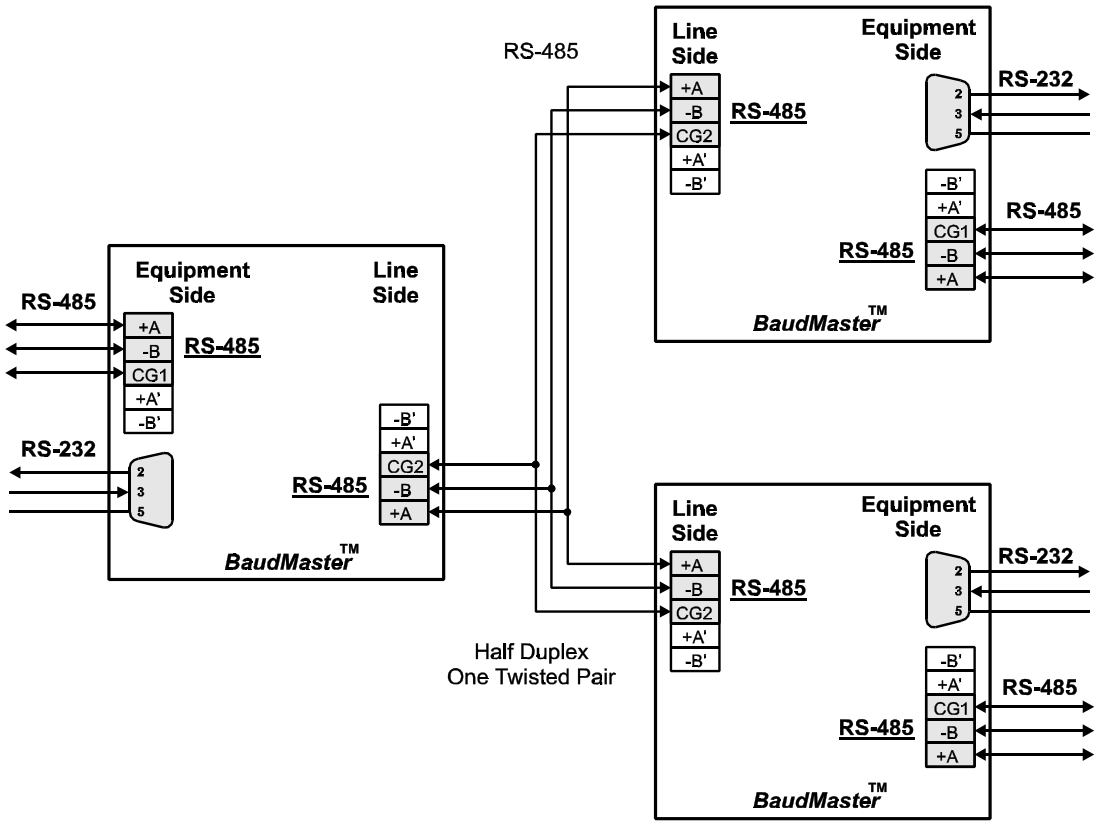
Half Duplex Line Extender



Full Duplex Line Extender



RS-485 Y Networks



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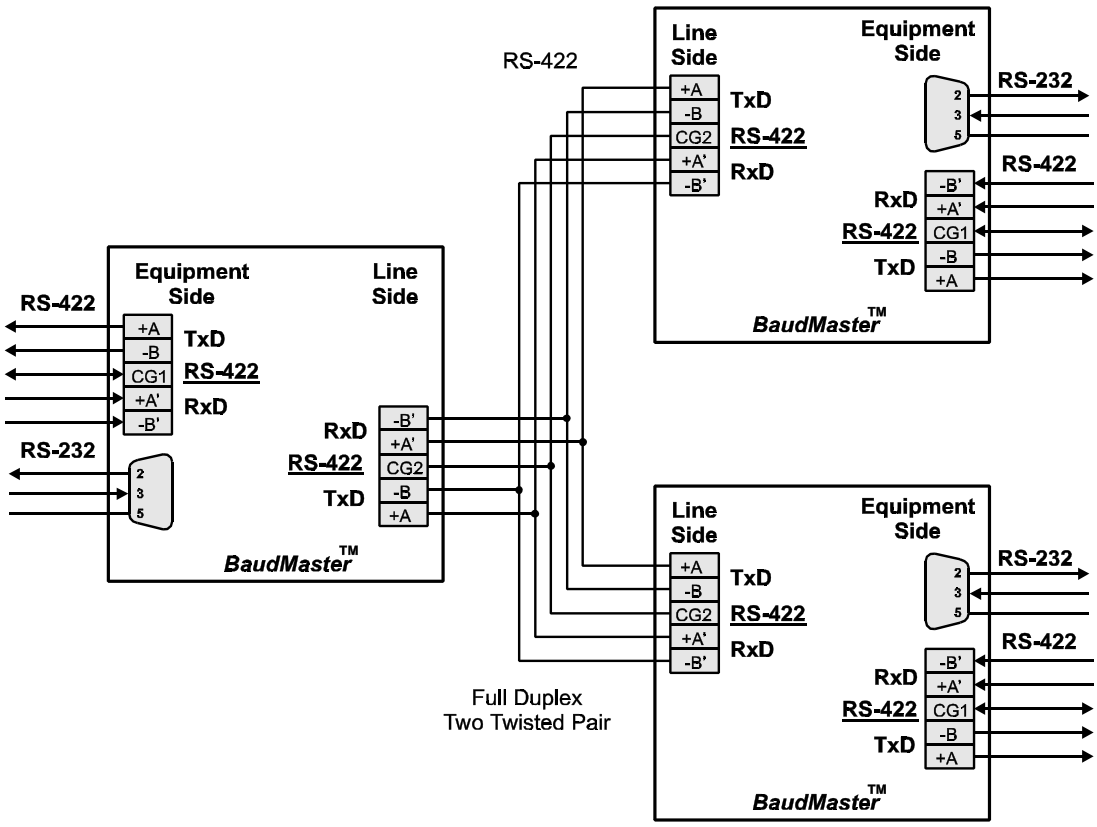
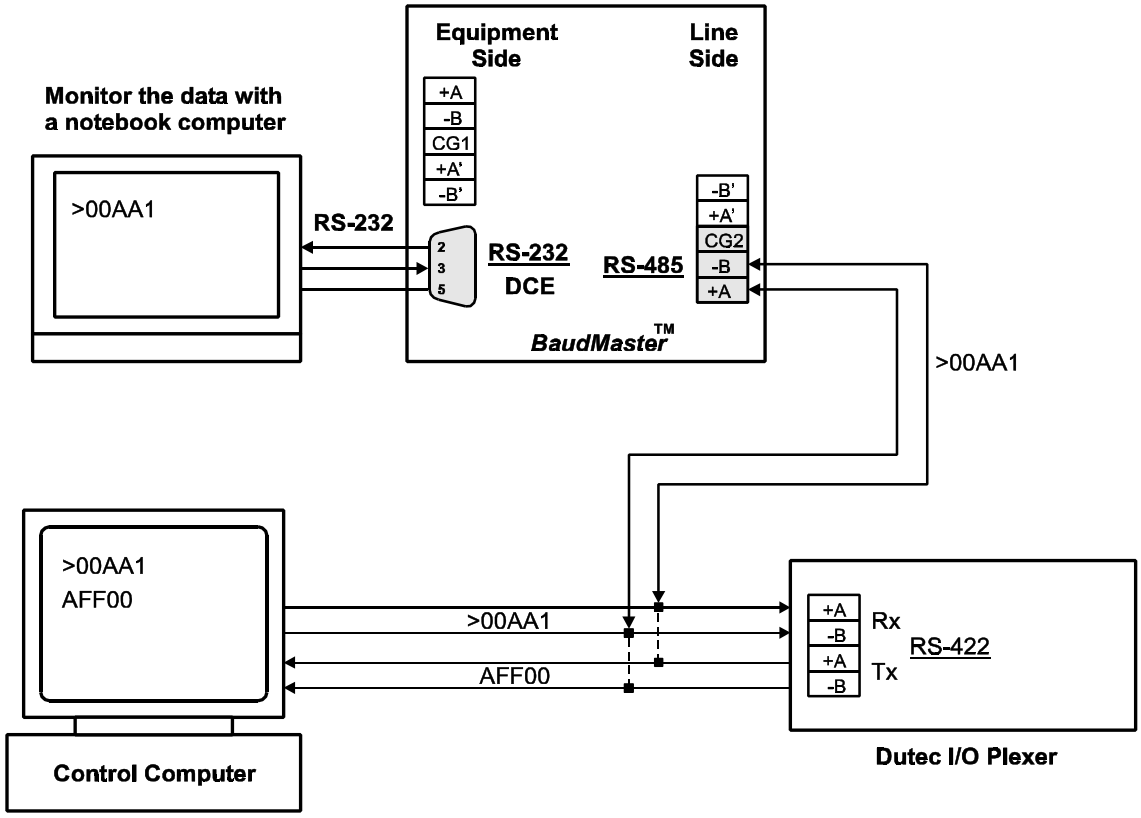
RS-422 Y Networks



A Troubleshooting Tool



Connect to either the Rx pair or Tx pair to monitor the RS-422 data at any point on the lines. Use a BaudMaster™ on an RS-485 network to monitor bidirectional data to any piece of equipment. Just add a parallel set of wires from the BaudMaster™ to the RS-485 connection on your equipment.

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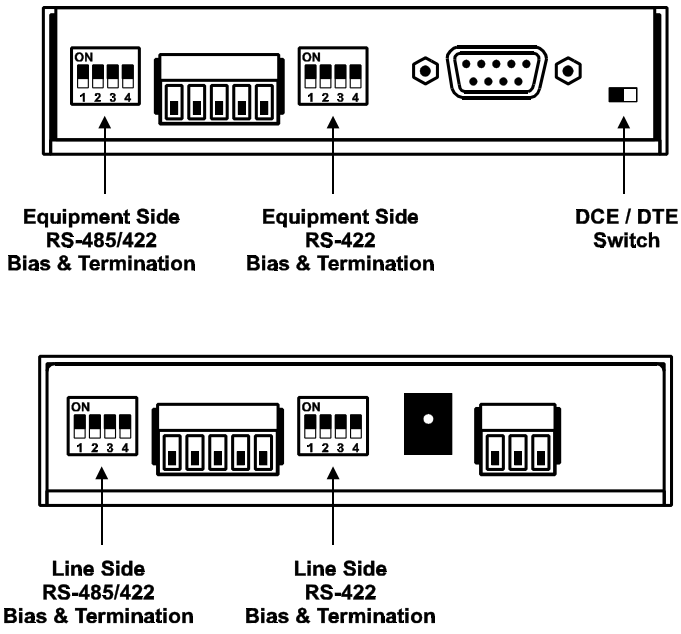
Configuration

The BaudMaster™ can be configured to accommodate various networks, cabling and protocols. This section describes how to set up the RS-485/422 and RS-232 options.



DCE/DTE Switch

The RS-232 port can be configured as a DTE (Data Terminal Equipment) or DCE (Data Communications Equipment) device. A DTE device is usually a PC or terminal and has a male connector. The DCE device is normally a remote device such as a modem and has a female connector. For more information see the RS-232 section on page 19.

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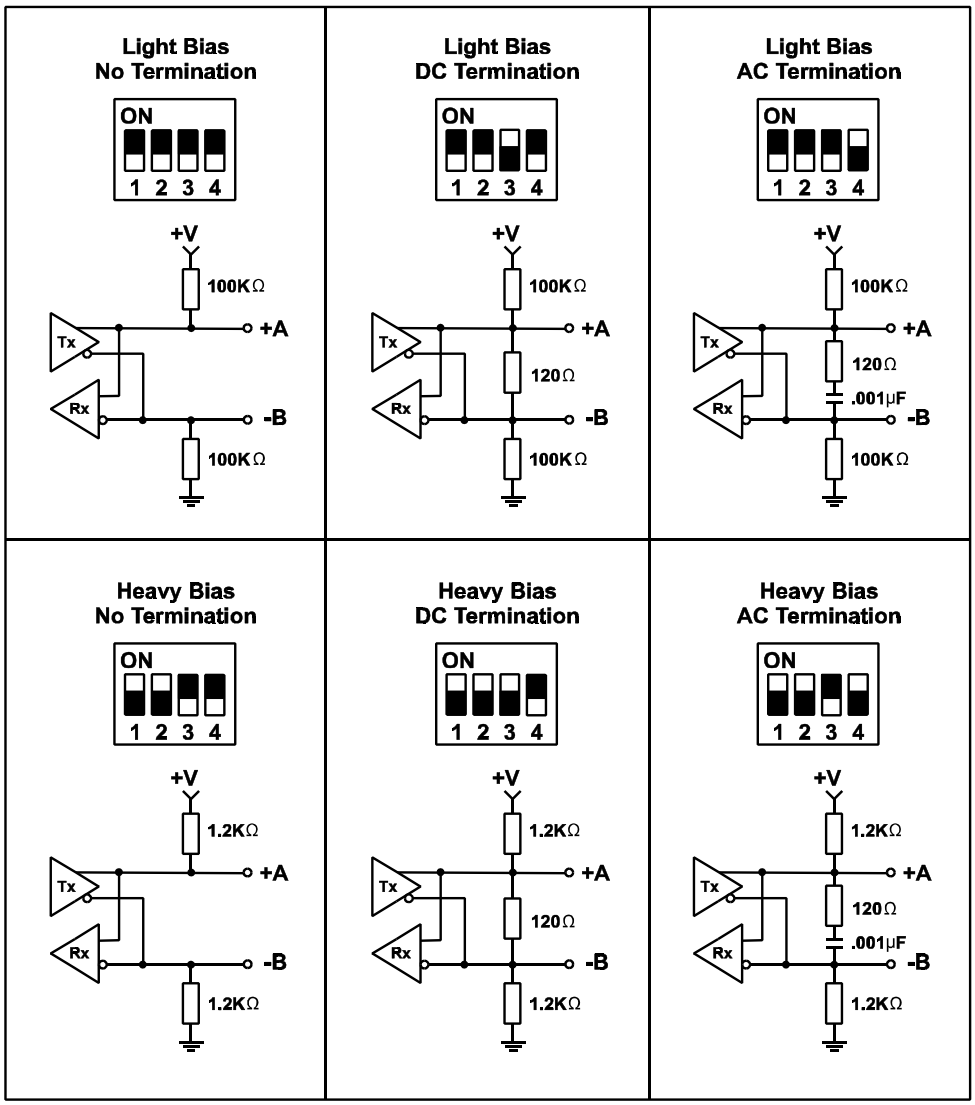
Termination Options

The BaudMaster™ provides several options for terminating an RS-485 or RS-422 bus. The decision of what kind of termination depends on data rate, cable length and other nodes on the bus. Bias resistors and terminating resistors are used to maintain the proper idle voltage state and to prevent transmission line reflections. The kind of termination is selected with the DIP switches.

RS-485 Transceiver Termination



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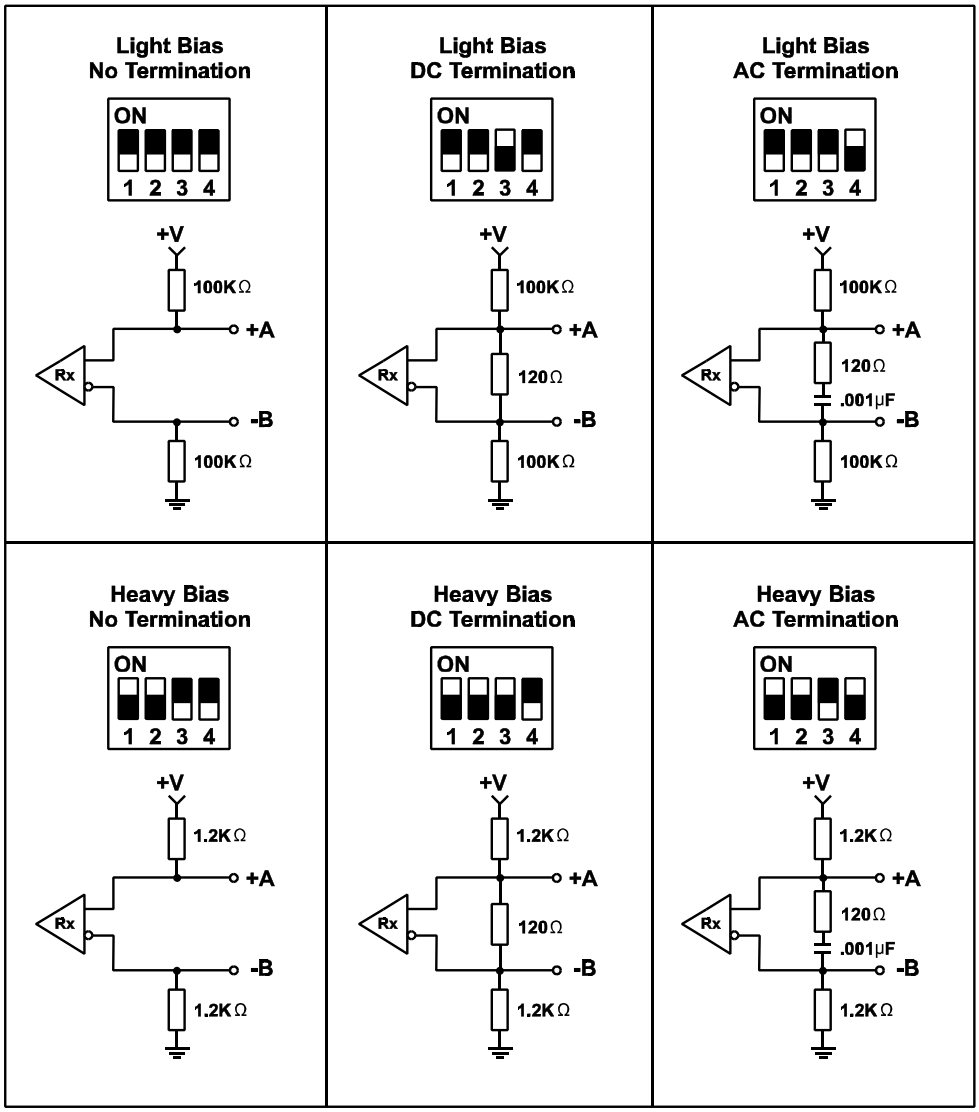
RS-422 Receiver Termination

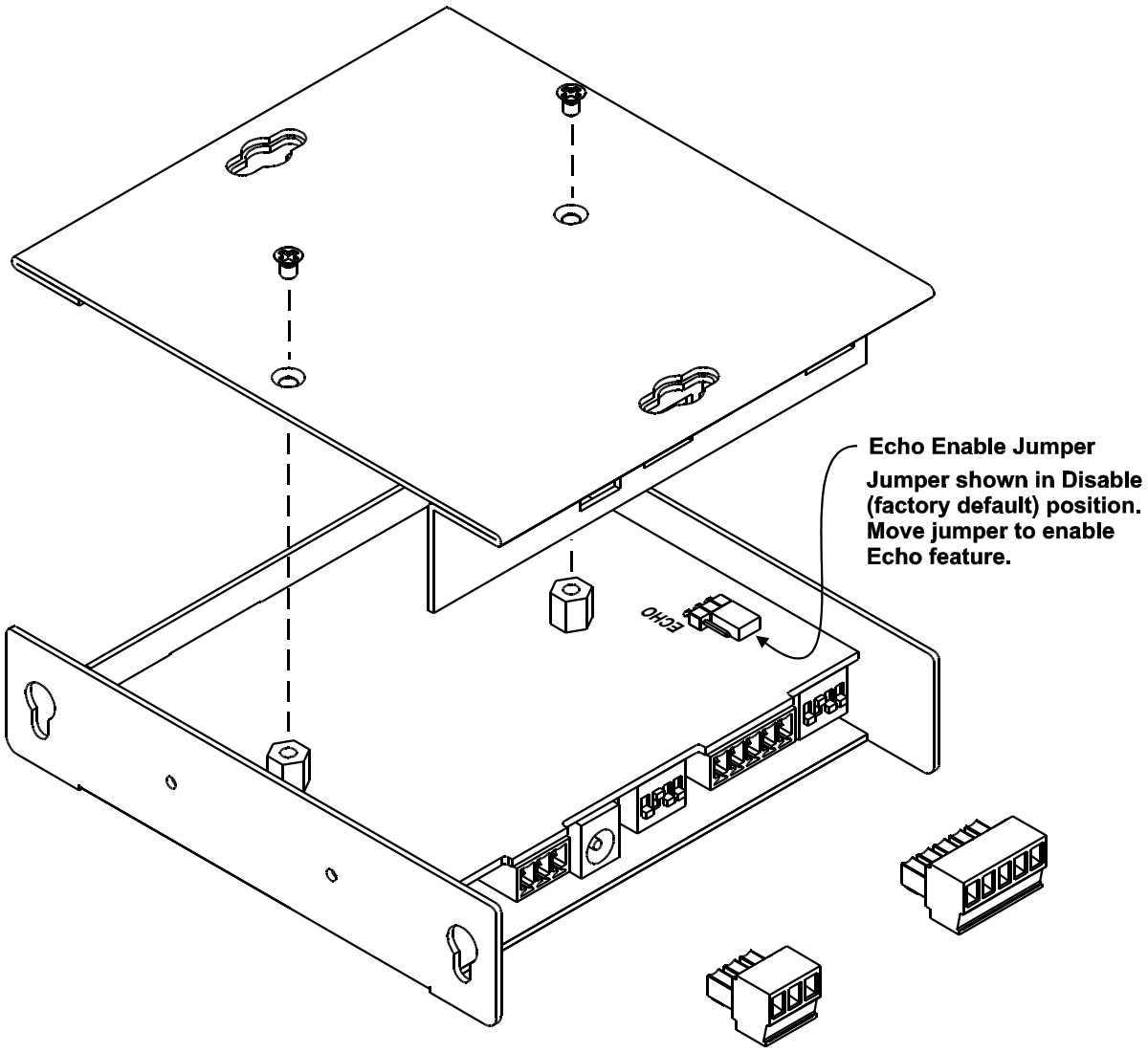


Note: If you are adding the BaudMaster™ to an existing network and are not sure what kind of termination to use, select *Light Bias, No Termination*.

Echo Mode

Echo mode keeps the line side (RS-485) receiver always enabled. Therefore data transmitted to the equipment side (RS-232 or RS-485) is returned. This may be required for some software protocols. With echo off, the receiver is disabled when the transmitter is enabled and the data is not returned. Note: Do not enable echo in RS-422 full-duplex networks.

To access the jumper, remove the two pluggable terminal blocks and the two screws as shown. Remove the stainless steel bottom cover to access the jumper.



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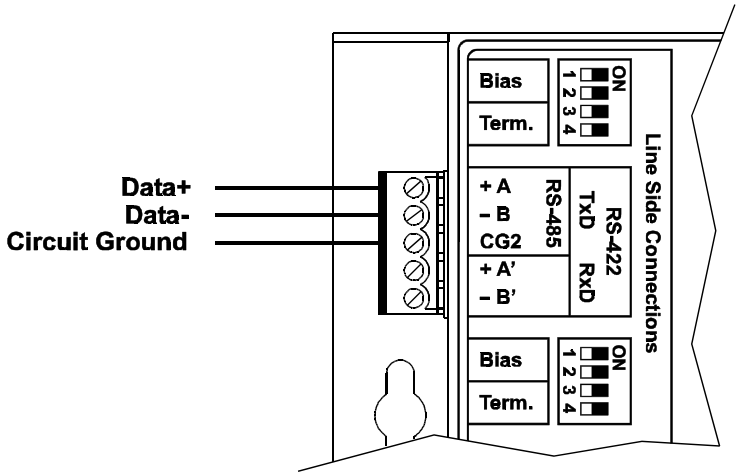
Wiring

Line Side RS-485 Wiring

When using the Line Side RS-485 option, you will need to connect three wires to the BaudMaster™ RS-485 terminal block from opposite connection. Connect Data+ to +A, Data- to -B and Circuit Ground to CG2.

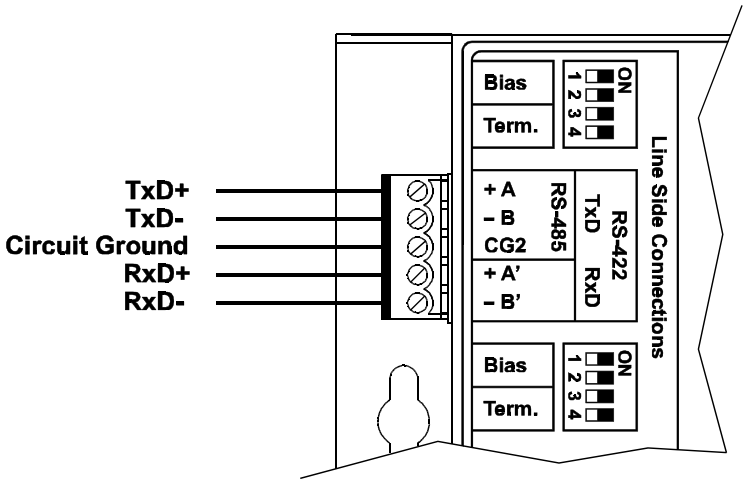
See page 23for recommendations on selecting the appropriate RS-485 cable.



Line Side RS-422 Wiring

When using the Line Side RS-422 option, you will need to connect five wires to the BaudMaster™ RS-422 terminal block from the opposite connection. Connect Transmit Data+ to +A, Transmit Data- to -B, Circuit Ground to CG2, Receive Data+ to +A' and Receive Data- to -B'.

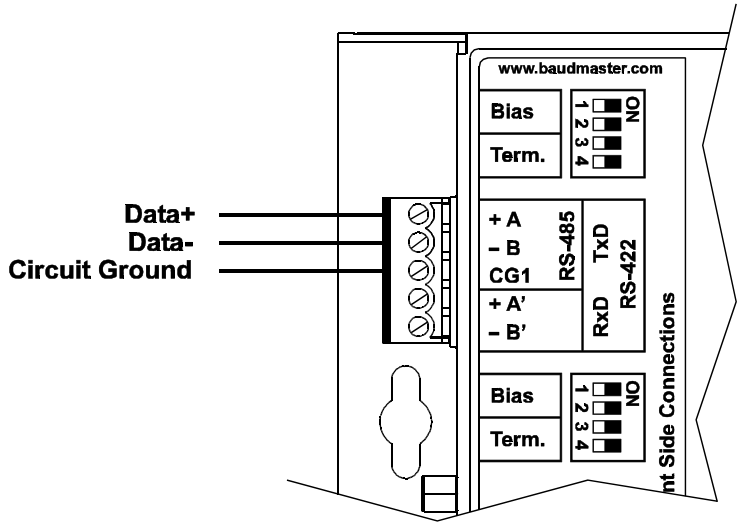
See page 23 for recommendations on selecting the appropriate RS-422 cable.



Equipment Side RS-485 Wiring

When using the Equipment Side RS-485 option, you will need to connect three wires to the BaudMaster™ RS-485 terminal block from opposite connection. Connect Data+ to +A, Data- to -B and Circuit Ground to CG2.

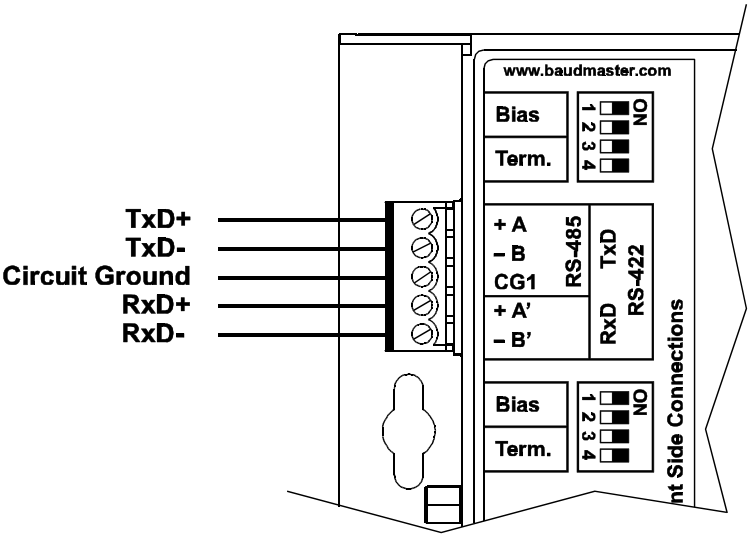
See page 23 for recommendations on selecting the appropriate RS-485 cable.



Equipment Side RS-422 Wiring

When using the Equipment Side RS-422 option, you will need to connect five wires to the BaudMaster™ RS-422 terminal block from the opposite connection. Connect Transmit Data+ to +A, Transmit Data- to -B, Circuit Ground to CG2, Receive Data+ to +A' and Receive Data- to -B'.

See page 23 for recommendations on selecting the appropriate RS-422 cable.



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RS-232 Connection

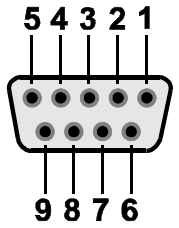
The RS-232 connection uses a standard female 9 pin D-Sub connector.

RS-232 Pinout

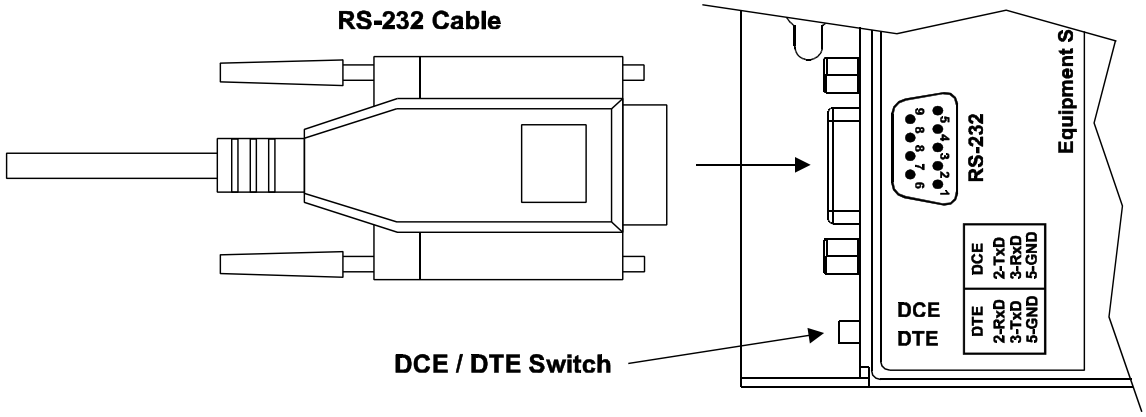
Pin #	Set for DCE	Set for DTE	Note
1	DCD	DCD	Pulled high with 4.7K Resistor
2	TxD	RxD	Transmit/Receive
3	RxD	TxD	Receive/Transmit
4	DSR	DTR	Connected to Pin 6
5	Circuit Ground	Circuit Ground	
6	DTR	DSR	Connected to Pin 4
7	CTS	RTS	Connected to Pin 8
8	RTS	CTS	Connected to Pin 7
9	NC	NC	No Connection

Pins 1, 4, 6, 7 and 8 are connected to the correct levels to allow the device connected to operate under most conditions without additional loopback connections.

The DCE-DTE switch provides a convenient way to configure the BaudMaster™ as a DCE or DTE device. This allows the use of a "straight-through" or "null modem" RS-232 cable. Units shipped from the factory are set for DCE operation.

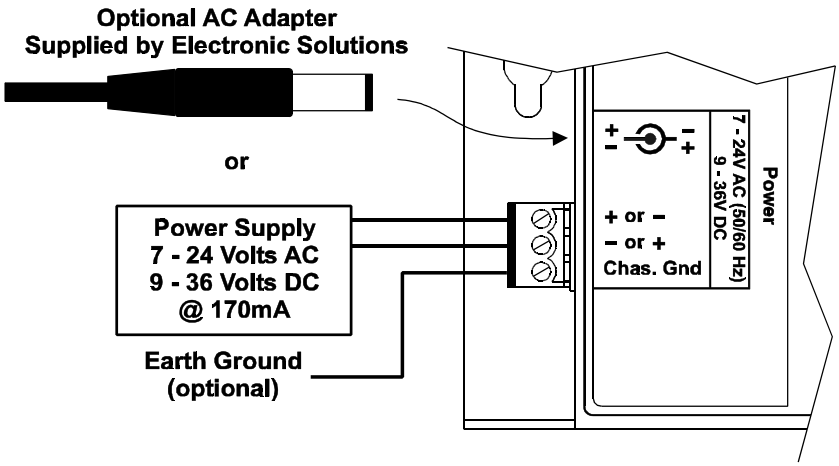


DB9 Female



Power Supply Wiring

The BaudMaster™ incorporates special power converter circuitry that allows it to be powered by a wide range of AC or DC power. The maximum current draw is 170 milliamps. Power can be supplied to the unit with an AC adapter available from duTec. The unit can also be powered by any power supply that meets the specifications as shown below.



The Earth Ground terminal is connected to the stainless steel chassis and is provided as a convenient way to secure the chassis to earth ground. This may be desirable or required for some applications.

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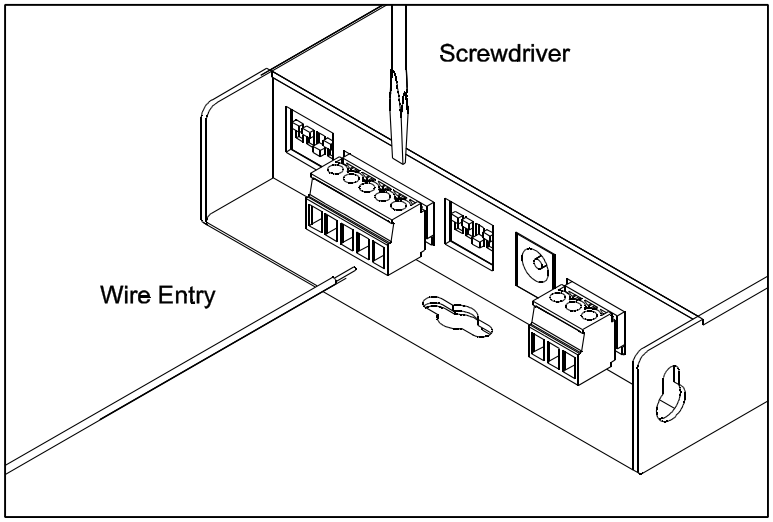
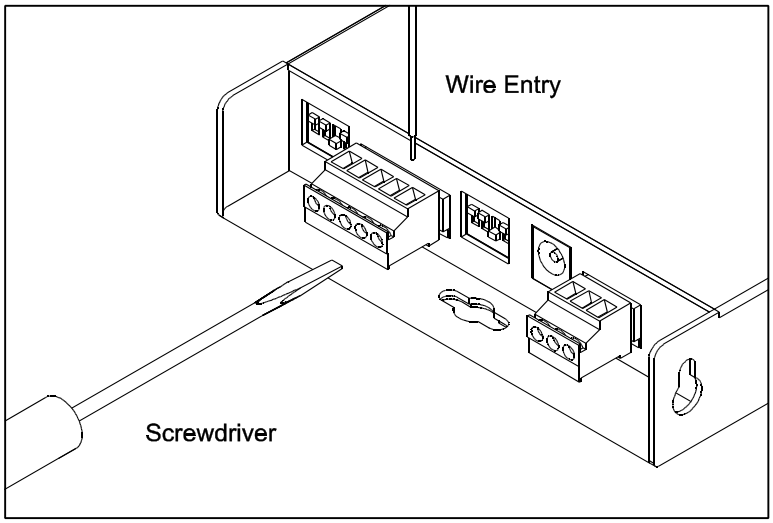
Termination Plugs

The termination plugs are available in two styles. The parallel style allows the wire to enter the terminals parallel to the unit. This style is standard and probably preferable in most cases.



Parallel Style Termination

The vertical style allows the wire to enter the terminals perpendicular to the unit.

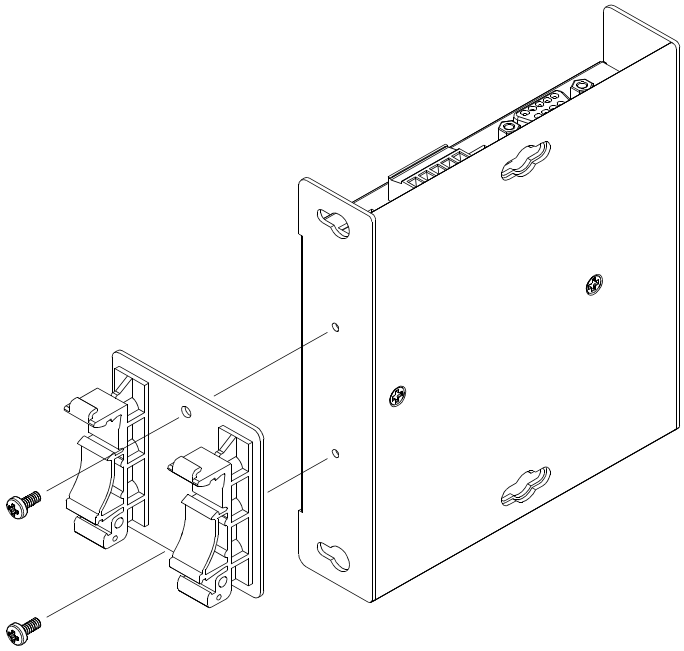


Vertical Style Termination

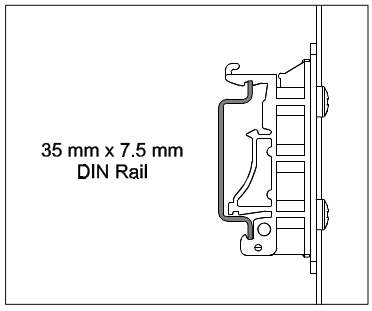
The termination style is specified in the BaudMaster™ order number. See the *Ordering Information* section on page 23.

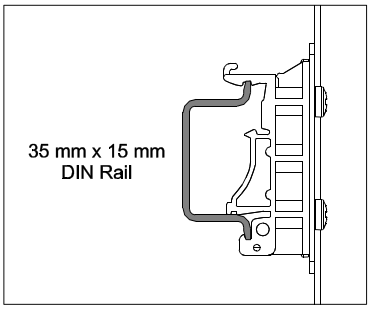
DIN Rail Adapter (DA-01)

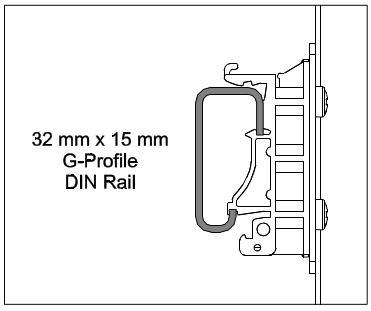
Fasten the optional DA-01 DIN Rail Adapter to the BaudMaster™ with the mounting screws provided.



Mounts to standard DIN rail profiles: 35 mm x 7.5 mm, 35 mm x 15 mm and 32 mm x 15 mm G-profile DIN Rail.







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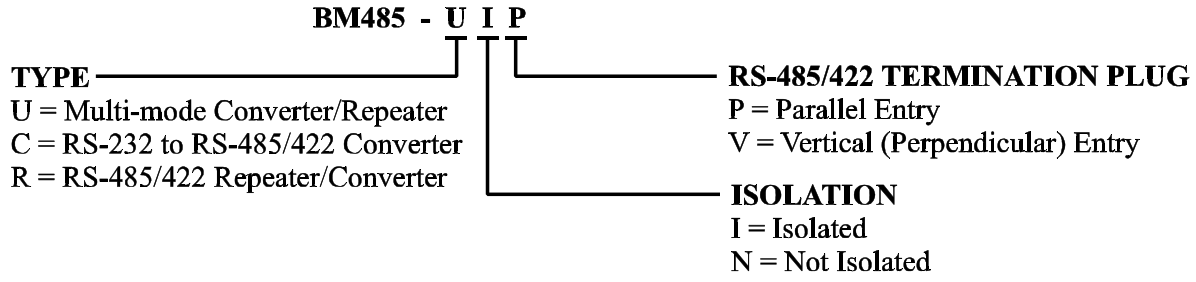
Ordering Information

The BaudMaster™ is available in 12 different configurations. Choose the model that best fits your application needs. See the website at *www.baudmaster.com* or call 800-248-1632 for current pricing.



Model	Auto Enable	Isolated	Description	Max BPS	Max Range (in feet)	Temperature
BM485-UIP	YES	YES	RS-485/422/232 MULTIMODE	115200	4000	-25°C TO 80°C
BM485-CIP	YES	YES	RS-232 to RS-485/422	115200	4000	-25°C TO 80°C
BM485-RIP	YES	YES	RS-485/422 to RS-485/422	115200	4000	-25°C TO 80°C
BM485-UIV	YES	YES	RS-485/422/232 MULTIMODE	115200	4000	-25°C TO 80°C
BM485-CIV	YES	YES	RS-232 to RS-485/422	115200	4000	-25°C TO 80°C
BM485-RIV	YES	YES	RS-485/422 to RS-485/422	115200	4000	-25°C TO 80°C
BM485-UNP	YES	NO	RS-485/422/232 MULTIMODE	115200	4000	-25°C TO 80°C
BM485-CNP	YES	NO	RS-232 to RS-485/422	115200	4000	-25°C TO 80°C
BM485-RNP	YES	NO	RS-485/422 to RS-485/422	115200	4000	-25°C TO 80°C
BM485-UNV	YES	NO	RS-485/422/232 MULTIMODE	115200	4000	-25°C TO 80°C
BM485-CNV	YES	NO	RS-232 to RS-485/422	115200	4000	-25°C TO 80°C
BM485-RNV	YES	NO	RS-485/422 to RS-485/422	115200	4000	-25°C TO 80°C

Optional Equipment

Model	Description
DA-01	DIN Rail Adapter (Includes adapter and mounting screws)
BM-PS120	Wall-Plug Adapter, 120VAC @ 3W
BM-PS220	Wall-Plug Adapter, 220VAC @ 3W
BM-PSU	Wall-Plug Adapter, Universal 90-264VAC @ 3W
GC-9M	Gender Changer, 9 pin D-sub Male/Male
CA-9F9M	Cable, DB-9 Serial Male/Female (for RS-232)

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Cable

RS-422 and RS-485 communications requires twisted pair, low capacitance cable, with a nominal impedance of 100-120 ohms. The decision to use shielded cable depends on the application.

RS-422 minimum cable requirements:
Shielded: two twisted pair with drain wire (use drain wire for signal ground)
Unshielded: three twisted pair (using the extra pair for signal ground)

RS-485 minimum cable requirements:
Shielded: one twisted pair with drain wire (use drain wire for signal ground)
Unshielded: two twisted pair (using the extra pair for signal ground)

Belden Shielded RS-422 Cable

Part No.	Wire	D.C. Resistance	Outside Diameter	Impedance	Capacitance	Propagation Velocity
9829	24 AWG (7x32)	24.0 Ω/1000' 78.7 Ω/km	.291 in. 7.39 mm	100 Ω	15.5 pF/ft. 59.1 pF/m	66%
8102	24 AWG (7x32)	24.0 Ω/1000' 78.7 Ω/km	.270 in. 6.86 mm	100 Ω	12.5 pF/ft. 41.0 pF/m	78%
8162	24 AWG (7x32)	24.0 Ω/1000' 78.7 Ω/km	.343 in. 8.71 mm	100 Ω	12.5 pF/ft. 41.0 pF/m	78%
1419A	24 AWG (7x32)	24.0 Ω/1000' 78.7 Ω/km	.248 in. 6.30 mm	100 Ω	13 pF/ft. 42.5 pF/m	78%
9729	24 AWG (7x32)	24.0 Ω/1000' 78.7 Ω/km	.317 in. 8.05 mm	100 Ω	12.5 pF/ft. 41.0 pF/m	78%
9842	24 AWG (7x32)	24.0 Ω/1000' 78.7 Ω/km	.340 in. 8.64 mm	120 Ω	12.8 pF/ft. 42.0 pF/m	66%
88102	24 AWG (7x32)	24.0 Ω/1000' 78.7 Ω/km	.227 in. 5.77 mm	100 Ω	12.95 pF/ft. 42.0 pF/m	78%
89729	24 AWG (7x32)	23.3 Ω/1000' 76.4 Ω/km	.271 in. 6.88 mm	100 Ω	12.5 pF/ft. 41.0 pF/m	78%

Belden Shielded RS-485 Cable

Part No.	Wire	D.C. Resistance	Outside Diameter	Impedance	Capacitance	Propagation Velocity
8132	28 AWG (7x36)	65 Ω/1000' 213 Ω/km	.235 in. 5.97 mm	120 Ω	11.0 pF/ft. 36.1 pF/m	78%
9841	24 AWG (7x32)	24.0 Ω/1000' 78.7 Ω/km	.340 in. 8.64 mm	120 Ω	12.8 pF/ft. 42.0 pF/m	66%

Category 3 (CAT-3) and Category 5 (CAT-5) cables are good choices for unshielded RS-485 and RS-422 cable.

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